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DEPARTMENT OF TRANSPORTATION
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1220 WASHINGTON AVE., STATE CAMPUS, ALBANY, NEW YORK 12232

TECHNICAL REPORT 83-3

ASPHALT CEMENT MONITOR PROGRAM, FALL 1982

MARCH, 1983

materials bureau technical services division

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ASPHALT CEMENT MONITOR PROGRAM
FALL 1982

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March 1983

MATERIALS BUREAU
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Preface

Each year the Materials Bureau conducts a monitor testing program in cooperation with various suppliers of asphalt cement. Samples are obtained by Bureau personnel and split for testing by both the supplier and the Bureau in accordance with standard AASHTO test procedures. This report summarizes the results of the 1982 program.

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I. Introduction

During September and October 1982, personnel from the Materials Bureau Chemical Laboratory Section obtained nineteen samples, from fifteen suppliers of asphalt cement. These samples represented many of the sources which had supplied material to the Department during the 1982 construction season including Normal, Canadian, Bos Can, Mid-Continent, Venezuelan and Mexican crude sources.

At the time of samples, the nineteen samples were split into two parts. One part was given to the asphalt supplier while the other was returned to the Bureau's Laboratory. All tests were conducted in accordance with the applicable AASHTO test procedure.

Two standard test report forms and one sample identification form were provided by the Bureau for recording sample information and all test results. Each supplier submitted the test results to the Bureau for review and incorporation into this report.

II. Sample Information

A. The distribution of the samples by grade was as follows:

Grade	Number of Samples
AC-5	2
AC-15	5
AC-20	7
85/100	5

B. The supplier, location, crude source and lot numbers are tabulated below.

AC-5

Supplier	Location	Lot	Crude Source
Ashland	Tonawanda	10	-
B.P. Oil	Oakville	54	Western Canada

AC-15

Supplier	Location	Lot	Crude Source
Ashland	Tonawanda	4	-
B.P. Oil	Oakville	246	Western Canada
Gulf Canada	Mississauga	12	Western Canada
Marathon	Tonawanda	10	Mid-Continent
United Refining	Warren, PA	4	Mid-Continent

AC-20

Supplier	Location	Lot	Crude Source
Arco	Philadelphia	33	Normal
Chevron	Perth Amboy	58	Normal
Cibro	Albany	14	Bos-Can
Exxon	Linden	13	Normal
Marathon	Tonawanda	4	Mid-Continent
Parco	Athens	22	Normal
West Bank	Kearny	4	Normal

85/100

Supplier	Location	Lot	Crude Source
B.P. Oil	Montreal	49	Western Canada and Mexican
Esso Petroleum	Montreal	9	Canadian and Venezuelan
Gulf Canada	Mississauga	13	Western Canada
Petro Canada	Montreal	10	Venezuelan and Mexican
Shell Canada	Montreal	-	Lagomar

III. Test Performed

A. Tests required by Department of Transportation Specification: (all tests not required on all items of asphalt cement)

1. Viscosity @ 140°F, Absolute, (AASHTO T202)
2. Viscosity @ 275°F, Kinematic, (AASHTO T201)
3. Penetration @ 77°F, (AASHTO T49)
4. Ductility @ 39.2°F, (AASHTO T51)
5. Flash Point, Cleveland Open Cup, (AASHTO T48)
6. Solubility in Trichloroethylene, (AASHTO T44)
7. % Loss on Thin Film Oven Test Residue, (AASHTO T179)
8. Penetration @ 77°F on Thin Film Oven Test Residue (AASHTO T49)
9. Penetration @ 77°F Ratio (% of Original) between the Thin Film Oven Test Residue and the Penetration @ 77°F on the original sample
10. Viscosity @ 140°, Absolute on Thin Film Oven Test Residue (AASHTO T202)
11. Ductility @ 77°F on Thin Film Oven Test Residue (AASHTO T51)

B. Additional tests not required by Department of Transportation Specifications:

1. Penetration @ 39.2°F (AASHTO T49)
2. Penetration Ratio: 39.2°F/77°F
3. Ductility @ 77°F, (AASHTO T51)
4. Specific Gravity @ 77°F (AASHTO T228)
5. Softening Point, Ethylene Glycol (AASHTO T53)
6. Viscosity @ 275°F, Kinematic, on Thin Film Oven Test Residue (AASHTO T201)
7. Ductility @ 60°F on Thin Film Oven Test Residue (AASHTO T51)
8. Viscosity @ 140°F, Absolute, Ratio, between viscosity @ 140°F, Absolute on Thin Film Oven Test Residue Sample and the original sample.
9. A Settling Test to Evaluate the Relative Degree of Dispersion of Asphaltenes.
10. Chemical Analysis of asphalt cement.

C. A Penetration Viscosity Number (PVN) and a Penetration Index Number (PIN) has been computed for each asphalt cement sample.

IV. Test Data and Sample Identification Forms

On the following pages are the Standard Test Report and Sample Identification Forms used for this project.

PRIMARY SOURCE	LOCATION
CRUDE SOURCE	SAMPLED AT
SAMPLED BY	DATE SAMPLED
ITEM NO.	GRADE TYPE
LOT NO,	DATE OF CERTIFICATION

REAMRKS:

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1982 ASPHALT MONITOR PROGRAM

		TEST NO.
PRIMARY SOURCE	LOCATION	
LOT NO.	ITEM NO.	GRADE TYPE

CRUDE SOURCE	AASHTO	RESULTS
1. Viscosity Ratio @ 140 F		
a.) Viscosity of Original Sample,(poises)	T 202	
b.) Viscosity After T.F.O.T.,(poises)	T 202	
2. Viscosity @ 275 F, Centistokes	T 201	
3. Penetration @ 77 F, 100g., 5 sec.	T 49	
4. Penetration @ 39.2 F, 200g., 60 sec.	T 49	
5. Penetration Ratio (39.2°F/77°F) 100		
6. Ductility @ 39.2 F, 1 cm/min., cm.	T 51	
7. Ductility @ 77 F, 5cm/min., cm.	T 51	
8. Flash Point C.O.C., F	T 48	
9. Solubility in Trichloroethylene	T 44	
10. Loss on Heating T.F.O.T.,Percent, 325F @ 5 Hrs	T 179	
11. Specific Gravity @ 77 F	T 228	
12. Ductility @ 60 F, T.F.O.T., 5cm/min., cm.	T 51	
13. Ductility @ 77 F, T.F.O.T., 5cm/min., cm.	T 51	
14. Penetration @ 77 F, T.F.O.T., 100g., 5 sec.	T 49	
a.) Percent of Original		
15. Viscosity @275 F After T.F.O.T. (cst)	T 201	
16. Penetration Viscosity Number, PVN		
17. Softening Point, Ethylene Glycol,°F	T 53	
18. Penetration Index Number, PIN		

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	TEST NO.
PRIMARY SOURCE	LOCATION

LOT NO.	ITEM NO.	GRADE TYPE
CRUDE SOURCE		

ASPHALT COMPOSITION ANALYSIS

ASPHALTENES, %	
SATURATES, %	
NAPHTHENE AROMATICS, %	
POLAR AROMATICS, %	

A Settling Test to Evaluate the Relative Degree of Dispersion of Asphaltenes

SETTLEMENT TIME, MINUTES	

V. NEW YORK STATE DEPARTMENT OF TRANSPORTATION SPECIFICATIONS FOR ASPHALT CEMENT

TABLE 702-1

ASPHALT CEMENTS FOR PAVING

MATERIAL DESIGNATION	702-0100		702-0200		702-0300		702-0400		702-0500	
VISCOSITY GRADE	AC-2.5		AC -5		AC-10		AC-15		AC-20	
Test Requirements	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Viscosity 140F (60 C), P	200	300	400	600	800	1200	1200	1800	1600	2400
Viscosity 275F(135 C), cSt	125		175		250		275		300	
Penetration 77F (25C),100g, 5s	200	325	120	200	70	120	60	100	60	100
Flash Point COC, F(C)	325(163)		350(177)		425(219)		435(225)		450(232)	
Solubility in Trichloroethylene,%	99.0		99.0		99.0		99.0		99.0	
Tests on Residue from Thin Film Oven Test										
Viscosity, 140 F(60C), P		1250		2500		5000		7500		10,000
Ductility, 77 F(25C) 5 cm/min., cm	100		100		75		60		50	
TYPICAL USES (intended only as a general information guide)	Recycle Mix		Hot plant mix very cold climate. Recycle Mix.		Hot plant mix cold climate. Recycle Mix.		Hot plant mix moderate climate.		Hot plant mix moderate climate. Sheet mixes. Open graded surface course mixes.	

TABLE 702-2

MISCELLANEOUS ASPHALT CEMENTS

MATERIAL DESIGNATION	702-0600	
GRADE	85-100	
TEST REQUIREMENTS	Min	Max
Penetration,77F(25C), 100g, 5s	85	100
Viscosity,275F(135C), cSt	280	
Flash Point, COC, F	450	
Solubility in trichloroethylene,%	99.5	
Ductility, 39.2F(4C), 1cm/min., cm	6	
Tests on residue from Thin-film Oven Test (AASHTO T179)		
Loss on Heating, 325F, 5h, %		.85
Penetration, % original	47	
Ductility, 77F(25C), 5cm/min., cm	75	
Typical Uses	Hot plant mix moderate climate	

VI. Summary of Test Results

Test results for all nineteen asphalt cement samples met New York State Department of Transportation Specification requirements.

VII. Test Results

On the following pages is a tabulation of all test results. The column headed by the name of the test contains the test result determined by the Materials Bureau. The column headed by "Comparative Results" contains the test result provided by the supplier for the test indicated in the column immediately to the left.

1982 Asphalt Cement Monitor Program

AC	Supplier - Location - Lot	Crude Source	Absolute Viscosity @ 140°F	Comparative Results	Kinematic Viscosity @ 275°F	Comparative Results	Penetration @ 77°F	Comparative Results	Penetration @ 39.2°F	Comparative Results	Penetration Ratio 39.2/77°F	Comparative Results
5	Ashland, Tonawanda 10		450	*	216	*	59	*	42	*	26	*
5	B.P. Oil, Oakville 54	W. Canada	544	552	219	221	62	62	46	*	28	*
	$\bar{X}$		497		218		61		44		27	
	σ		665		2.1		2		2.8		1.4	
15	Ashland, Tonawanda 4		1462	*	349	*	73	*	26	*	36	*
15	B.P. Oil, Oakville 246	W. Canada	1338	1370	340	240	86	87	27	*	31	*
15	Gulf Canada, Mississauga 12	W. Canada	1220	1335	315	303	86	85	26	24	30	28.2
15	Marathon, Tonawanda 10	Mid-Cont.	1368	1424	338	335.5	90	94	28	32	31	34
15	United Ref., Warren 4	Mid-Cont.	1542	1544	355	350	66	67	20	20	30	29.9
	$\bar{X}$		1386	1418	339	307	80	83	25	25	32	31
	σ		122.8	91.5	15.3	48.9	10.2	11.5	3.1	6.1	2.5	3.0
20	Arco, Philadelphia 33	Normal	1801	1912	410	356	71	72	24	26	34	36
20	Chevron, Perth Amboy 58	Normal	1778	1800	403	397	79	71	26	*	33	*
20	Cibro, Albany 14	Bos-Can	2203	2302	500	509	90	91	36	26	40	28.57
20	Exxon, Linden 13	Normal	1998	2038	396	406	62	60	21	*	34	*
20	Marathon, Tonawanda 4	Mid-Cont.	1888	1938	397	383.6	71	74	24	27	34	36.5
20	Parco, Athens 22	Normal	2021	*	425	*	70	*	25	*	36	*
20	West Bank, Kearny 4	Normal	1941	1875	413	381	79	79	29	23	37	29.1
	$\bar{X}$		1947	1978	421	405	75	75	26	26	35	33
	σ		145.5	177.1	36.4	53.5	9.0	10.2	4.9	1.7	2.4	4.3
85/100	B.P. Oil, Montreal 49	W. Can. & Mex	1310	1380	340	327	85	90	29	34	34	37.8
85/100	Esso Petro., Montreal 9	Can. & Ven.	1226	1368.4	322	302.6	86	87	29	29	34	33
85/100	Gulf Canada, Mississauga 13	W. Canada	1220	1310	314	304	86	85	27	28	31	27.05
85/100	Petro Canada, Montreal 10	Ven. & Mex.	1218	1213	322	323	96	96	35	34	36	35.4
85/100	Shell Canada, Montreal	Lagomar	1187	*	333	327	100	93	36	*	36	*
	$\bar{X}$		1232	1318	326	317	91	90	31	30	34	33
	σ		46.1	76.3	10.3	12.4	6.9	4.4	4.0	5.2	2.1	4.6

*Results Not Given

1982 Monitor Program AC	Supplier - Location - Lot	Crude Source	T.F.O.T. Loss %	Comparative Results	T.F.O.T. Ductility @ 60°F	Comparative Results	T.F.O.T. Ductility @ 77°F	Comparative Results	T.F.O.T. Viscosity @ 140°F	Comparative Results	T.F.O.T. Viscosity Ratio	Comparative Results
5	Ashland, Tonawanda 10		0.190	*	0.850	*	50.0+	*	996	*	2.21	*
5	B.P. Oil, Oakville 54	W. Canada	+0.027 gain	+0.056 gain	50.0+	*	50.0+	50.0+	1172	1110	2.15	2.01
	$\bar{X}$		0.095		29.75		150.0+		1084		2.18	
	σ		0.134		28.6		+		124.5		0.04	
15	Ashland, Tonawanda 4		0.088	*	25.0	*	50.0+	*	3249	*	2.22	*
15	B.P. Oil, Oakville 246	W. Canada	+0.072 gain	0.12	50.0+	*	50.0+	50.0+	2665	2740	1.99	2.0
15	Gulf Canada, Mississauga 12	W. Canada	0.231	0.19	50.0+	150.0+	50.0+	50.0+	2749	2763	2.25	2.07
15	Marathon, Tonawanda 10	Mid-Cont.	0.316	0.33	50.0+	150.0+	50.0+	50.0+	3437	3563	2.51	2.50
15	United Ref., Warren 4	Mid-Cont.	+0.044 gain	+0.045 gain	40.50	32.0	50.0+	40.0+	3200	3191	2.08	2.07
	$\bar{X}$		0.127	0.160	103.1	110.7	50.0+		3060	3064.3	2.21	2.16
	σ		0.142	0.138	64.5	68.1	+		335.5	391.9	0.20	0.23
20	Arco, Philadelphia 33	Normal	+0.001 gain	0.00	44.50	30.0	50.0+	00.0+	4578	4303	2.54	2.25
20	Chevron, Perth Amboy 58	Normal	+0.058 gain	+0.03 gain	54.75	63.0	50.0+	00.0+	4111	4470	2.31	2.50
20	Cibro, Albany 14	Bos-Can	0.881	0.65	83.50	37.5	50.0+	50.0+	7906	7638	3.59	3.32
20	Exxon, Linden 13	Normal	+0.058 gain	0.149	72.0	59.0	50.0+	00.0+	4020	3706	2.01	1.80
20	Marathon, Tonawanda 4	Mid-Cont.	0.143	0.16	104.0	50.0	50.0+	50.0+	4572	4940	2.42	2.55
20	Parco, Athens 22	Normal	0.002	*	32.50	*	50.0+	*	4925	*	2.44	*
20	West Bank, Kearny 4	Normal	0.295	0.256	53.25	85.0	50.0+	50.0+	5496	5003	2.83	2.67
	$\bar{X}$		0.189	0.203	63.5	54.1	50.0+		5087	5010	2.59	2.52
	σ		0.325	0.241	24.5	19.7	+		338.9	371.4	0.50	0.50
85/100	B.P. Oil, Montreal 49	W. Can & Mex	0.007	0.02	45.25	45.0	50.0+	28.0	3461	3202	2.64	2.30
85/100	Esso Petro., Montreal 9	Can. & Ven.	+0.059 gain	0.00	22.0	29.0	50.0+	50.0+	3439	3651.1	2.81	2.67
85/100	Gulf Canada, Mississauga 13	W. Canada	0.216	0.18	50.0+	150.0+	50.0+	50.0+	2702	2705	2.21	2.07
85/100	Petro Canada, Montreal 10	Ven. & Mex.	0.043	0.05	29.25	30.0	50.0+	40.0+	3480	4120	2.86	3.39
85/100	Shell Canada, Montreal	Lagomar	+0.054 gain	+0.07 gain	50.0+	*	50.0+	50.0+	2331	*	1.96	*
	$\bar{X}$		0.053	0.050	79.3	63.5	50.0+		3082.6	3419.5	2.50	2.61
	σ		0.093	0.076	65.1	58.1	+		533.4	606.1	0.39	0.58

*Results Not Given

1982 Asphalt Cement Monitor Program

AC	Supplier - Location - Lot	Crude Source	T.F.O.T. Viscosity @275°F	Comparative Results	T.F.O.T. Penetration @77°F	Comparative Results	T.F.O.T. Penetration Ratio	Comparative Results	Specific Gravity @77°F	Comparative Results	C.O.C. Flash Point, °F	Comparative Results
5	Ashland, Tonawanda 10		295	*	90	*	56.6	*	1.005	*	560	*
5	B.P. Oil, Oakville 54	W. Canada	305	*	91	97	56.2	60	1.018	.0174	571	568.4
	$\bar{x}$		300		91		56.4		1.012		566	
	σ		7.1		0.7		0.3		0.009		7.8	
15	Ashland, Tonawanda 4		490	*	48	*	65.8	*	1.016	*	608	*
15	B.P. Oil, Oakville 246	W. Canada	450	*	56	55	65.1	63	1.023	.0225	602	644
15	Gulf Canada, Mississauga 12	W. Canada	440	427	53	58	61.6	68.2	1.022	.0246	640	550
15	Marathon, Tonawanda 10	Mid.-Cont.	499	486.6	52	53	57.8	56.4	1.027	.0276	545	585
15	United Ref., Warren 4	Mid.-Cont.	476	444	45	43	68.2	64.2	1.018	.013	645	630
	$\bar{x}$		471	453	51	52	63.7	63.0	1.021	.022	608	602
	σ		25.4	30.7	4.3	6.5	4.1	4.9	0.004	0.006	40	43
20	Arco, Philadelphia 33	Normal	581	573	49	50	69.0	69.4	1.026	.0259	598	590
20	Chevron, Perth Amboy 58	Normal	568	590	50	45	63.3	63	1.028	1.025	625	620
20	Cibro, Albany 14	Bos.-Can	891	902	48	49	53.3	53.85	1.032	.0389	481	485
20	Exxon, Linden 13	Normal	534	516	45	48	72.6	80	1.027	.0299	610	550+
20	Marathon, Tonawanda 4	Mid.-Cont.	568	579.9	44	44	62.0	59.5	1.029	1.028	571	565
20	Parco, Athens 22	Normal	600	*	47	*	67.1	*	1.028	*	591	*
20	West Bank, Kearny 4	Normal	627	534	47	50	59.5	63.3	1.019	1.020	562	590
	$\bar{x}$		624	616	47	48	63.8	64.8	1.027	1.028	577	
	σ		12.2	143.1	2	2.6	6.4	9.0	0.004	0.006	47	
85/100	B.P. Oil, Montreal 49	W. Can. & Mex.	495	465	52	54	61.2	60	1.026	.0234	565	601
85/100	Esso Petro., Montreal 9	Can. & Ven.	475	419.2	53	51	61.6	58.6	1.020	.0203	592	605
85/100	Gulf Canada, Mississauga 13	W. Canada	436	421	52	57	60.5	67.05	1.022	.0239	535	555
85/100	Petro Canada, Montreal 10	Ven. & Mex.	479	507	56	50	58.3	52.1	1.018	.0168	549	580
85/100	Shell Canada, Montreal	Lagomar	443	*	69	58	69.0	62.4	1.021	.0240	625	622
	$\bar{x}$		466	452	56	54	62.1	60.0	1.021	1.022	573	593
	σ		25.1	42.9	7.2	3.5	4.1	5.5	0.003	0.003	36	26

*Results Not Given

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AC	Supplier-Location-Lot	Crude Source	Ductility @ 39.2°F	Comparative Results	Ductility @ 77°F	Comparative Results	Solubility %	Comparative Results	Softening Point, °F	PVN	Comparative Results	PIN
5	Ashland, Tonawanda 10		94.00	*	150.0+	*	99.96	*	103	+0.659	*	+1.251
5	B.P. Oil, Oakville 54	W. Canada	50.0+	15.0+	50.0+	*	99.99	99.92	107	+0.613	+0.598	+0.262
	$\bar{x}$		122.0		50.0+		99.98		105	+0.636		+0.757
	σ		39.6		+		0.02		2.8	0.033		0.699
15	Ashland, Tonawanda 4		9.75	*	50.0+	*	99.97	*	119	+0.771	*	+0.707
15	B.P. Oil, Oakville 246	W. Canada	61.50	15.0+	50.0+	*	99.99	99.90	118	+0.638	+1.147	+0.404
15	Gulf Canada, Mississauga 12	W. Canada	92.0	50.0+	50.0+	150.0+	99.98	99.99	117	+0.752	+0.822	+0.564
15	Marathon, Tonawanda 10	Mid-Cont.	50.0+	15.0+	50.0+	150.0+	99.99	99.83	117	+0.597	+0.561	+0.430
15	United Ref., Warren 4	Mid-Cont.	8.25	*	50.0+	140.0+	99.99	*	121	+0.847	+0.852	+0.673
	$\bar{x}$		64.3		50.0+		99.98	99.91	118	+0.721	+0.846	+0.556
	σ		59.7		+		0.01	0.08	1.7	0.102	0.240	0.137
20	Arco, Philadelphia 33	Normal	12.50	*	50.0+	100.0+	99.99	99.99	122	+0.566	+0.756	+0.334
20	Chevron, Perth Amboy 58	Normal	24.00	*	50.0+	*	99.99	99.80	119	+0.477	+0.613	+0.490
20	Cibro, Albany 14	Bos-Can	122.50	28.0	50.0+	150.0+	99.98	99.99	120	+0.007	+0.033	+0.047
20	Exxon, Linden 13	Normal	10.75	*	50.0+	*	99.99	99.98	123	+0.754	+0.751	+0.546
20	Marathon, Tonawanda 4	Mid-Cont.	24.75	15.0	50.0+	150.0+	99.99	99.83	123	+0.613	+0.619	+0.189
20	Parco, Athens 22	Normal	11.25	*	50.0+	*	99.98	*	123	+0.529	*	+0.228
20	West Bank, Kearny 4	Normal	39.50	7.0	50.0+	150.0+	99.99	99.80	120	+0.441	+0.560	+0.336
	$\bar{x}$		35.0	16.7	50.0+		99.99	99.90	121	+0.484	+0.544	+0.297
	σ		32.9	10.6	+		0.00	0.10	1.7	0.234	0.294	0.199
85/100	B.P. Oil, Montreal 49	W. Can. & Mex.	16.75	12.0	50.0+	150.0+	99.97	99.96	119	+0.650	+0.647	+0.280
85/100	Esso Petro., Montreal 9	Can. & Ven.	17.25	11.0	50.0+	150.0+	99.98	99.80	120	+0.719	+0.800	+0.090
85/100	Gulf Canada, Mississauga 13	W. Canada	76.75	50.0+	50.0+	150.0+	99.97	99.98	119	+0.757	+0.817	+0.246
85/100	Petro Canada, Montreal 10	Ven. & Mex.	39.00	23.0	50.0+	140.0+	99.98	99.92	118	+0.600	+0.596	+0.071
85/100	Shell Canada, Montreal	Lagomar	150.0+	100+	50.0+	150.0+	99.99	99.90	115	+0.503	+0.612	+0.443
	$\bar{x}$		60.0		50.0+		99.98	99.91	118	+0.646	+0.694	+0.226
	σ		55.8		+		0.01	0.07	1.9	0.100	0.106	0.152

* Results Not Given

1982 Asphalt Cement Monitor Program

AC	Supplier - Location - Lot	Crude Source	Settlement Test Minutes	Asphaltenes %	Saturates %	% Naphthene Aromatics	% Polar Aromatics
5	Ashland, Tonawanda 10		87.8	10.1	13.6	31.7	38.9
5	B.P. Oil, Oakville 54	W. Canada	27.6	11.0	13.1	27.2	43.8
	$\bar{x}$		57.7	10.6	13.4	29.5	41.4
	σ		42.6	0.6	0.4	3.2	3.5
15	Ashland, Tonawanda 4		74.8	12.2	11.1	29.7	41.4
15	B.P. Oil, Oakville 246	W. Canada	27.8	11.4	8.6	28.7	46.2
15	Gulf Canada, Mississauga 12	W. Canada	25.0	10.8	10.8	28.1	44.0
15	Marathon, Tonawanda 10	Mid-Cont.	40.7	12.1	7.9	25.7	47.2
15	United Ref., Warren 4	Mid-Cont.	61.3	10.3	12.6	26.6	43.8
	$\bar{x}$		45.9	11.4	10.2	27.8	44.5
	σ		21.6	0.8	1.9	1.6	2.3
20	Arco, Philadelphia 33	Normal	27.4	14.7	9.3	29.2	41.5
20	Chevron, Perth Amboy 58	Normal	41.0	13.1	8.6	31.8	40.9
20	Cibro, Albany 14	Bos-Can	12.8	17.6	6.4	22.3	45.6
20	Exxon, Linden 13	Normal	32.2	13.1	8.2	28.6	44.2
20	Marathon, Tonawanda 4	Mid-Cont.	36.9	12.7	11.9	23.1	46.4
20	Parco, Athens 22	Normal	27.0	15.0	8.3	29.9	40.3
20	West Bank, Kearny 4	Normal	74.5	12.7	9.7	29.6	40.9
	$\bar{x}$		36.0	14.1	8.9	27.8	42.8
	σ		19.2	1.8	1.7	3.6	2.5
85/100	B.P. Oil, Montreal 49	W. Can. & Mex.	28.7	14.3	10.1	29.0	41.6
85/100	Esso Petro., Montreal 9	Can. & Ven.	36.5	14.0	11.9	29.8	40.2
85/100	Gulf Canada, Mississauga 13	W. Canada	26.2	11.2	9.7	30.2	42.1
85/100	Petro Canada, Montreal 10	Ven. & Mex.	53.6	14.4	14.9	27.2	37.6
85/100	Shell Canada, Montreal	Lagomar	16.4	12.6	7.7	33.9	39.2
	$\bar{x}$		52.3	13.3	10.9	30.0	40.1
	σ		37.4	1.4	2.7	2.5	1.8

* Results Not Given

VIII. Statistical Analysis of Test Results

The mean, range and standard deviation were determined for the number of samples tested in each grade of asphalt cement. For each test, this statistical information has been determined separately for the Materials Bureau results and when applicable, the comparable results submitted by the supplier.

A. Absolute Viscosity @ 140°F (Poises)

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	497	1386	1947	1232
Range	450 to 544	1220 to 1542	1778 to 2203	1187 to 1310
Stan. Deviation	66.5	122.8	145.5	46.1

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	4	6	4
Mean	-	1418	1978	1318
Range	-	1335 to 1544	1800 to 2302	1213 to 1380
Stan. Deviation	-	91.5	177.1	76.3

B. Kinematic Viscosity @ 275°F (Centistokes)

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	218	339	421	326
Range	216 to 219	315 to 355	396 to 500	314 to 340
Stan. Deviation	2.1	15.3	36.4	10.3

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	4	6	5
Mean	-	307	405	317
Range	-	240 to 350	356 to 509	302.6 to 327
Stan. Deviation	-	48.9	53.5	12.4

C. Penetration @ 77°F

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	161	80	75	91
Range	159 to 162	66 to 90	62 to 90	85 to 100
Stan. Deviation	2.1	10.2	9.0	6.9

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	4	6	5
Mean	-	83	75	90
Range	-	67 to 94	60 to 91	85 to 96
Stan. Deviation	-	11.5	10.2	4.4

D. Penetration @ 39.2°F

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	44	25	26	31
Range	42 to 46	20 to 28	21 to 36	27 to 36
Stan. Deviation	2.8	3.1	4.9	4.0

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	0	3	4	4
Mean	-	25	26	30
Range	-	20 to 32	23 to 27	23 to 34
Stan. Deviation	-	6.1	1.7	5.2

E. Penetration Ratio
(Pen. @ 39.2°F ÷ Pen. @ 77°F x 100)

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	27	32	35	34
Range	26 to 28	30 to 36	33 to 40	31 to 36
Stan. Deviation	1.4	2.5	2.4	2.1

E. Penetration Ratio (con't)

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	0	3	4	4
Mean	-	31	33	33
Range	-	28.2 to 34	28.57 to 36.5	27.05 to 37.8
Stan. Deviation	-	3.0	4.3	4.6

F. Thin Film Oven Test, % Loss

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	0.095	0.127	0.189	0.053
Range	0.000 to 0.190	0.000 to 0.316	0.000 to 0.881	0.000 to 0.216
Stan. Deviation	0.134	0.142	0.325	0.093

(Samples which showed weight gains were calculated as 0.000% Loss.)

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	4	6	5
Mean	-	0.160	0.203	0.050
Range	-	0.00 to 0.33	0.00 to 0.65	0.00 to 0.18
Stan. Deviation	-	0.138	0.241	0.076

(Samples which showed weight gains were calculated as 0.000% Loss.)

G. Thin Film Oven Test, Ductility @ 60°F, 5 cm/min. (Centimeters)

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	129.75	103.1	63.5	79.3
Range	109.5 to 150.0+	25.0 to 150.0+	32.5 to 104.0	22.0 to 150.0+
Stan. Deviation	28.6	64.5	24.5	65.1

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	0	3	6	4
Mean	-	110.7	54.1	63.5
Range	-	32.0 to 150.0+	30.0 to 85.0	29.0 to 150.0+
Stan. Deviation	-	68.1	19.7	58.1

H. Thin Film Oven Test, Ductility @ 77°F, 5 cm/min. (Centimeters)

1. Materials Bureau

All samples exceeded 150.0 cm.

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	4	6	5
Mean	-	-	-	-
Range	-	140.0+ to 150.0+	100.0+ to 150.0+	128.0 to 150.0+
Stan. Deviation	-	-	-	-

I. Thin Film Oven Test, Absolute Viscosity @ 140°F (Poises)

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	1084	3060	5087	3083
Range	996 to 1172	2665 to 3437	4020 to 7906	2331 to 3480
Stan. Deviation	124.5	335.5	1338.9	533.4

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	4	6	4
Mean	-	3064	5010	3420
Range	-	2740 to 3563	3706 to 7638	2705 to 4120
Stan. Deviation	-	391.9	1371.4	606.1

J. Absolute Viscosity @ 140°F Ratio (After TFOT Viscosity @ 140°F ÷ Original Viscosity @ 140°F)

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	2.18	2.21	2.59	2.50
Range	2.15 to 2.21	1.99 to 2.51	2.01 to 3.59	1.96 to 2.86
Stan. Deviation	0.04	0.20	0.50	0.39

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	4	6	4
Mean	-	2.16	2.52	2.61
Range	-	2.00 to 2.50	1.80 to 3.32	2.07 to 3.39
Stan. Deviation	-	0.23	0.50	0.58

K. Thin Film Oven Test, Kinematic Viscosity @ 275°F (Centistokes)

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	300	471	624	466
Range	295 to 305	440 to 499	534 to 891	436 to 495
Stan. Deviation	7.1	25.4	121.2	25.1

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	0	3	6	4
Mean	-	453	616	452
Range	-	427 to 486.6	516 to 902	415.2 to 507
Stan. Deviation	-	30.7	143.1	42.9

L. Thin Film Oven Test, Penetration @ 77°F

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	91	51	47	56
Range	90 to 91	45 to 56	44 to 50	52 to 69
Stan. Deviation	0.7	4.3	2.1	7.2

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	4	6	5
Mean	-	52	48	54
Range	-	43 to 58	44 to 50	50 to 58
Stan. Deviation	-	6.5	2.6	3.5

M. Penetration @ 77°F Ratio (After TFOT Pen. @ 77°F ÷ Original Pen. @ 77°F x 100)

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	56.4	63.7	63.8	62.1
Range	56.2 to 56.6	57.8 to 68.2	53.3 to 72.6	58.3 to 69.0
Stan. Deviation	0.3	4.1	6.4	4.1

M. Penetration @ 77°F Ratio (con't)

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	4	6	5
Mean	-	63.0	64.8	60.0
Range	-	56.4 to 68.2	53.85 to 80	52.1 to 67.05
Stan. Deviation	-	4.9	9.0	5.5

N. Specific Gravity @ 77°F

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	1.012	1.021	1.027	1.021
Range	1.005 to 1.018	1.016 to 1.027	1.019 to 1.032	1.018 to 1.026
Stan. Deviation	0.009	0.004	0.004	0.003

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	4	6	5
Mean	-	1.022	1.028	1.022
Range	-	1.013 to 1.026	1.020 to 1.0389	1.0168 to 1.0240
Stan. Deviation	-	0.006	0.006	0.003

O. Flash Point, Cleveland Open Cup, (°F)

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	566	608	577	573
Range	560 to 571	545 to 645	481 to 625	535 to 625
Stan. Deviation	7.8	40	47	36

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	4	6	5
Mean	-	602	-	593
Range	-	550 to 644	485 to 550+	555 to 622
Stan Deviation	-	43	-	26

P. Ductility @ 39.2°F, 1 cm/min. (Original Sample) (Centimeters)

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	122.0	64.3	35.9	60.0
Range	94.0 to 150.0+	8.25 to 150.0+	10.75 to 122.50	16.75 to 150.0+
Stan. Deviation	39.6	59.7	39.9	55.9

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	3	3	5
Mean	-	-	16.7	-
Range	-	15.0+ to 150.0+	7.0 to 28.0	10.0+ to 150.0+
Stan. Deviation	-	-	10.6	-

Q. Ductility @ 77°F, 5 cm/min. (Original Sample) (Centimeters)

1. Materials Bureau

All samples exceeded 150.0 cm.

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	0	3	4	5
Mean	-	-	-	-
Range	-	140.0+ to 150.0+	100.0+ to 150.0+	140.0+ to 150.0+
Stan. Deviation	-	-	-	-

R. Solubility in Trichloroethylene, (%)

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	99.98	99.98	99.99	99.98
Range	99.96 to 99.99	99.97 to 99.99	99.98 to 99.99	99.97 to 99.99
Stan. Deviation	0.02	0.01	0.00	0.01

R. Solubility in Trichloroethylene, (%) (con't)

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	3	6	5
Mean	-	99.91	99.90	99.91
Range	-	99.83 to 99.99	99.80 to 99.99	99.80 to 99.98
Stan. Deviation	-	0.08	0.10	0.07

S. Softening Point, Ethylene Glycol, (^{o}F)

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	105	118	121	118
Range	103 to 107	117 to 121	119 to 123	115 to 120
Stan. Deviation	2.8	1.7	1.7	1.9

T. Penetration Viscosity Number, (PVN)

The penetration viscosity number, PVN, is an indicator of the temperature susceptibility of asphalt cements. Lower PVN indicates greater temperature susceptibility. It is suggested that an asphalt cement with a PVN less than -0.5 is temperature susceptible.

$$PVN = \frac{\text{Log A} - \text{Log V}}{\text{Log A} - \text{Log B}} \times (-1.5)$$

Where Log A = 4.25800 - 0.79674 Log (Penetration @ 77°F)
Log B = 3.46289 - 0.61094 Log (Penetration @ 77°F)
Log V = Log (Viscosity @ 275°F, Kinematic)

The results indicate that most of these asphalt cements are temperature susceptible by PVN criteria.

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	-0.636	-0.721	-0.484	-0.646
Range	-0.613 to -0.659	-0.597 to -0.847	-0.007 to -0.754	-0.503 to -0.757
Stan. Deviation	0.033	0.012	0.234	0.100

2. Comparative Results

	AC-5	AC-15	AC-20	85/100
No. of Samples	1	4	6	5
Mean	-	-0.846	-0.544	-0.694
Range	-	-0.561 to -1.147	+0.033 to -0.756	-0.596 to -0.817
Stan. Deviation	-	0.240	0.294	0.106

U. Penetration Index Numbers, (PIN)

The penetration Index Number is another indicator of temperature susceptibility of asphalt cements. Large negative values of PIN indicate greater temperature susceptibility. "Typical" asphalts have values between +2 and -2.

$$PIN = \frac{30}{1 + 90\ PTS} - 10$$

PTS = Penetration Temperature Susceptibility

$$PTS = \frac{\text{Log } 800 - \text{Log (Penetration @ } 77^{o}F)}{\text{Softening Point } (^{o}F) - 77^{o}F}$$

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	-0.757	-0.556	-0.297	-0.226
Range	-0.262 to -1.251	-0.404 to -0.707	+0.047 to -0.546	-0.071 to -0.443
Stan. Deviation	0.699	0.137	0.199	0.152

V. A Settling Test to Evaluate The Relative Degree of Dispersion of Asphaltenes

by

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The asphaltene settling test is used to evaluate the relative degree of dispersion of asphaltenes from paving asphalts. This test distinguishes differences in asphaltene settling times of asphalts in their hexane-maltene solutions. The test involves digesting asphalt in n-hexane, transferring the contents into a graduated cylinder and measuring the time required for the asphaltene meniscus to settle to the 25 ml. mark of a 50 ml. cylinder. Slower settling times indicate a greater degree of dispersion of the asphaltenes and thus a more compatible asphalt, which in turn is considered to be an important property that contributes to asphalt durability. The test is extremely sensitive to changes in asphalt composition. Time is reported in minutes.

V. A Settling Test to Evaluate The Relative Degree of Dispersion of Asphaltenes (con't)

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	57.7	45.9	36.0	52.3
Range	27.6 to 87.8	25.0 to 74.8	12.8 to 74.5	26.2 to 116.4
Stan. Deviation	42.6	21.6	19.2	37.4

W. Asphalt Composition Analysis, by Liquid Chromatographic Separation and Densimetric Characterization

(Proposed) 1982 Annual ASTM Standards
Part 15, pages 1289 to 1296

The purpose is to separate the four generic fractions present in asphalt. These fractions are saturates, naphthene aromatics, polar aromatics, and asphaltenes. The relative amount of each fraction plays a role in determining the physical properties of the asphalt. These properties include viscosity, ductility, softening point and temperature susceptibility.

The procedure follows:

The percent asphaltene is determined by dispersing the asphalt in n-heptane and refluxing. The insolubles are the asphaltenes.

The remaining three fractions are determined by absorbing the deasphaltened n-heptane solution on a calcined alumina chromatography column and eluting (removing) each fraction with a different solvent. Saturates are eluted with n-heptane. Naphthene aromatics are eluted with toluene. Polar Aromatics are eluted with 50/50 toluene - methanol solution, followed by trichloroethylene. The solvents are then evaporated and weight percentages of each fraction with respect to the original asphalt sample are determined.

Asphaltenes, %

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	10.6	11.4	14.1	13.3
Range	10.1 to 11.0	10.3 to 12.2	12.7 to 17.6	11.2 to 14.4
Stan. Deviation	0.6	0.8	1.8	1.4

Saturates, %

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	13.4	10.2	8.9	10.9
Range	13.1 to 13.6	7.9 to 12.6	6.4 to 11.9	7.7 to 14.9
Stan. Deviation	0.4	1.9	1.7	2.7

Naphthene - Aromatics, %

1. Materials Bureau

	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	29.5	27.8	27.8	30.0
Range	27.2 to 31.7	25.7 to 29.7	22.3 to 31.8	27.2 to 33.9
Stan. Deviation	3.2	1.6	3.6	2.5

Polar Aromatics, %

1. Materials Bureau

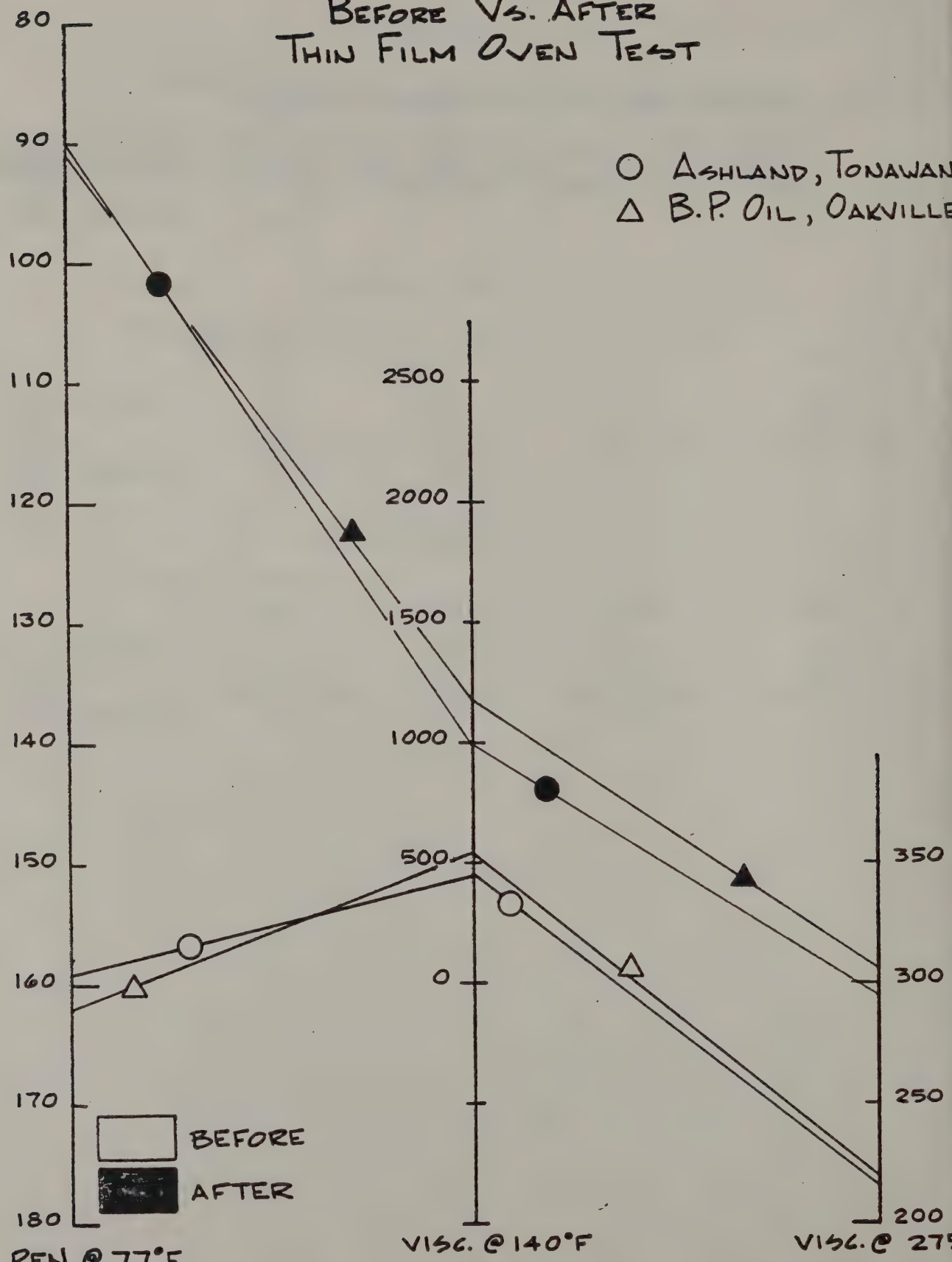
	AC-5	AC-15	AC-20	85/100
No. of Samples	2	5	7	5
Mean	41.4	44.5	42.8	40.1
Range	38.9 to 43.8	41.4 to 47.2	40.3 to 46.4	37.6 to 42.1
Stan. Deviation	3.5	2.3	2.5	1.8

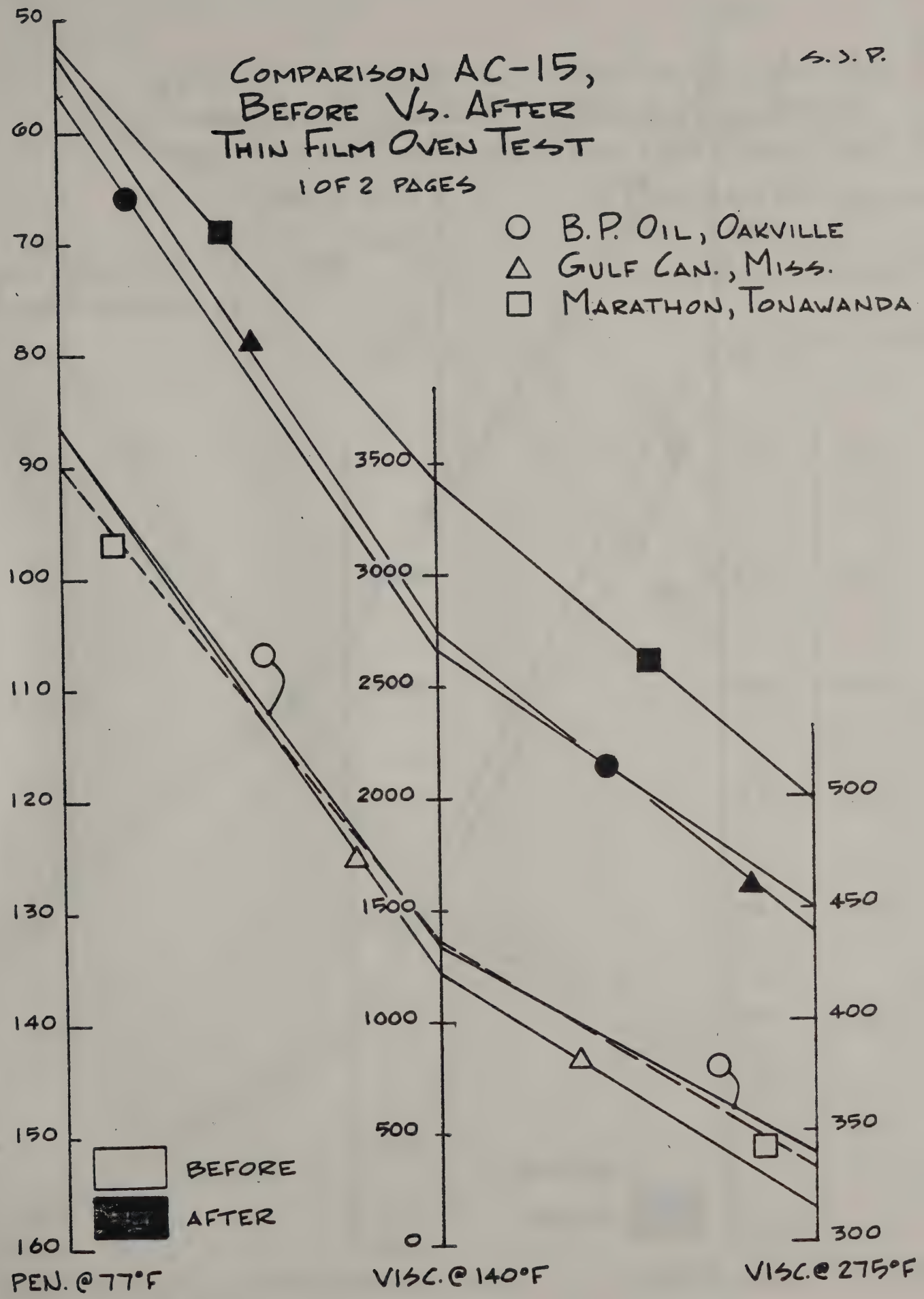
IX. GRAPHS AND CHARTS OF RELATED MATERIAL INFORMATION

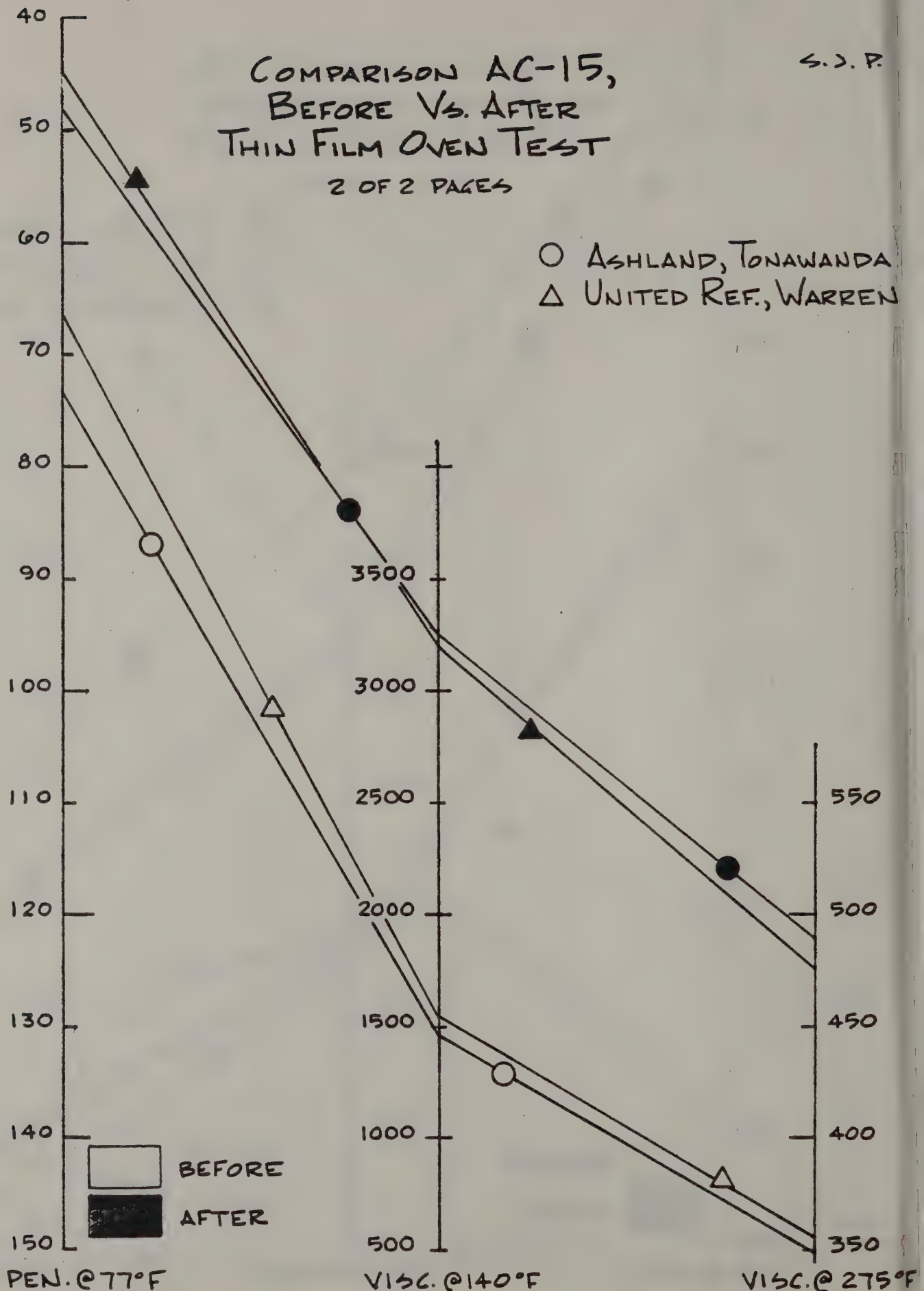
On the following pages are found a series of graphs and charts providing a comparison of Thin Film Oven Test, Before and After, and charts showing Settling Test, Asphaltene Dispersion.

S.J.P.

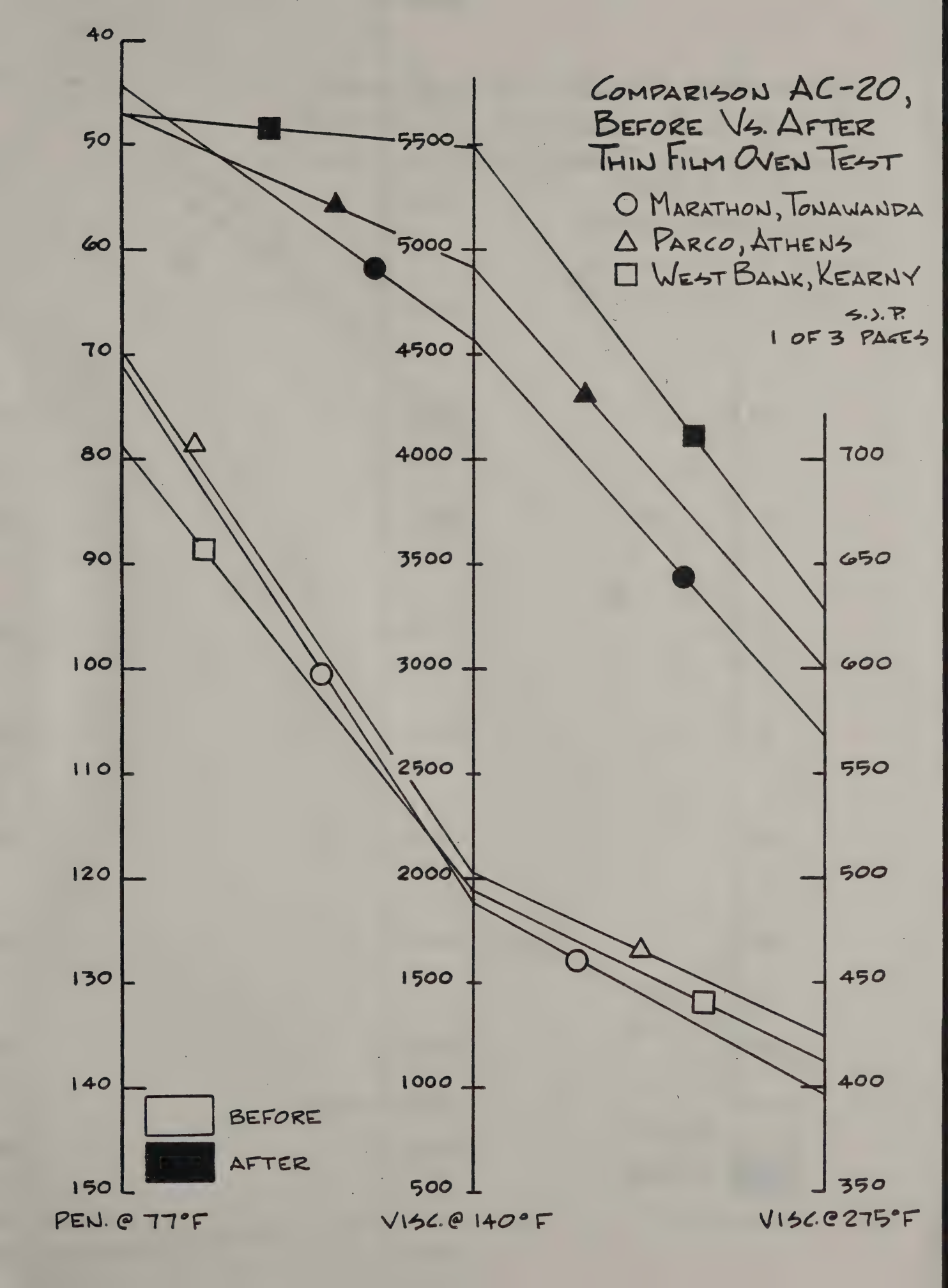
Comparison AC-5, Before Vs. After Thin Film Oven Test

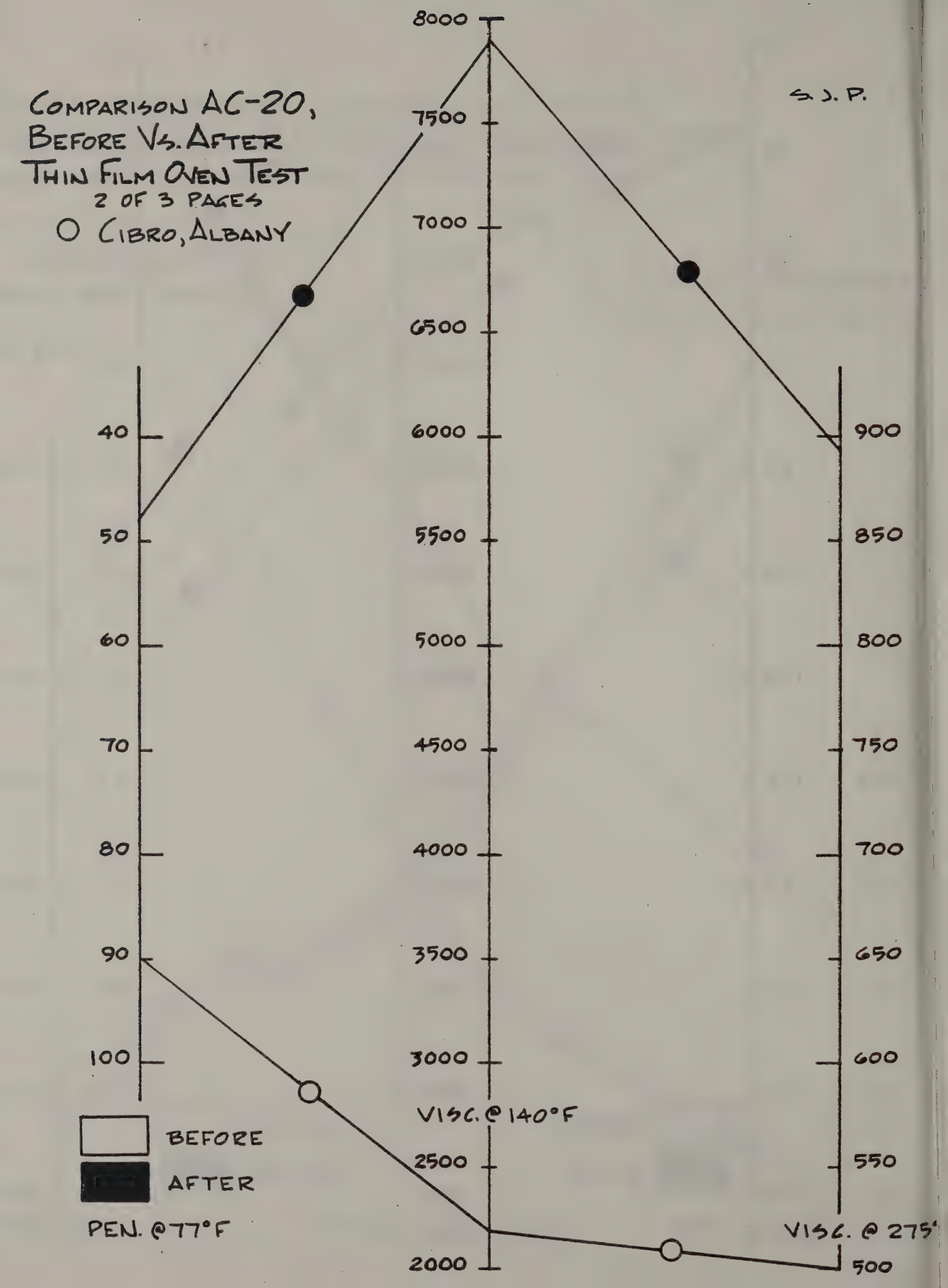


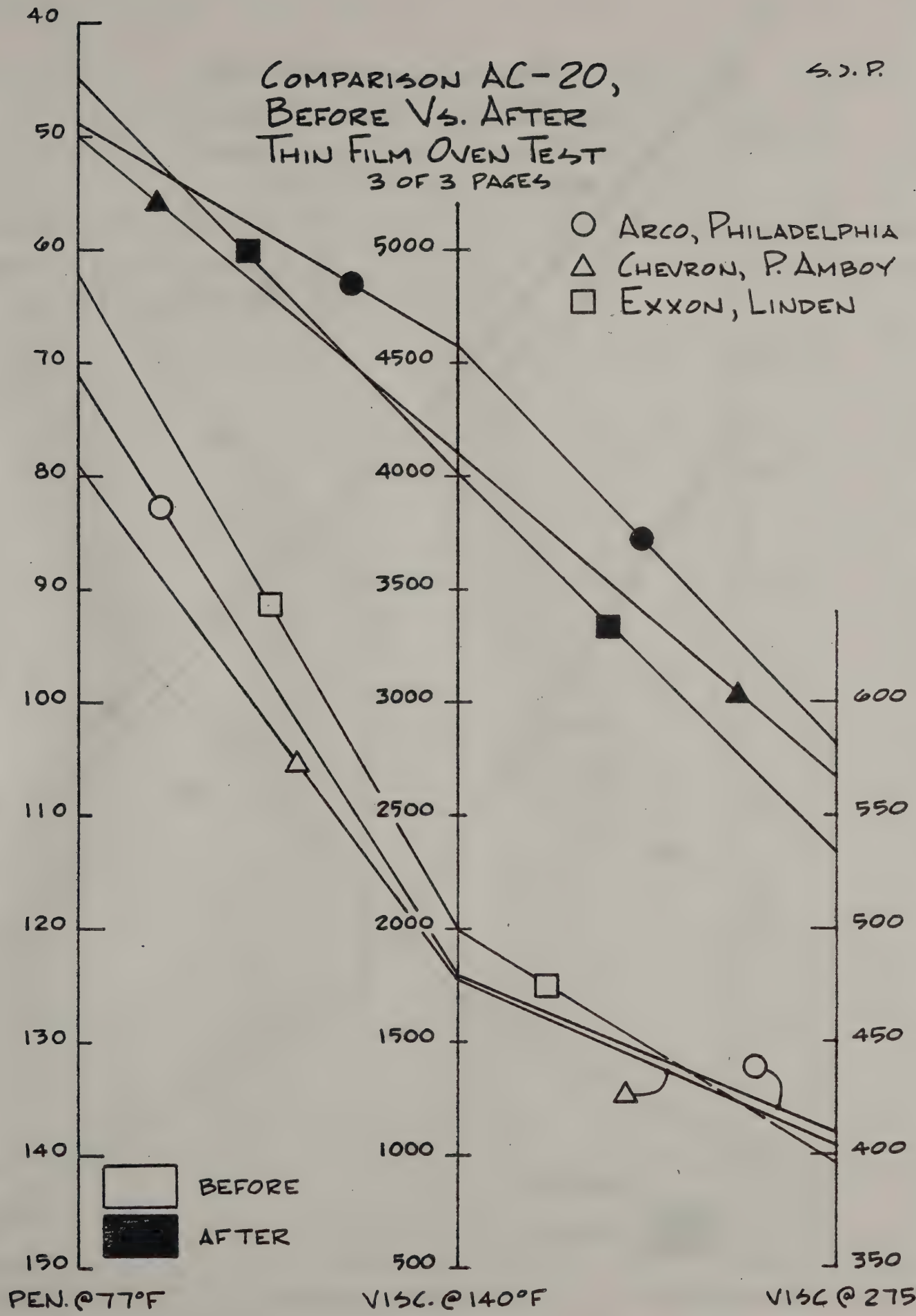

COMPARISON AC-15,
BEFORE VS. AFTER
THIN FILM OVEN TEST
1 OF 2 PAGES
S. J. P.
B.P. OIL, OAKVILLE
GULF CAN., MISS.
MARATHON, TONAWANDA
BEFORE
AFTER
PEN. @ 77°F
VISC. @ 140°F
VISC. @ 275°F
50
60
70
80
90
100
110
120
130
140
150
160
3500
3000
2500
2000
1500
1000
500
0
500
450
400
350
300

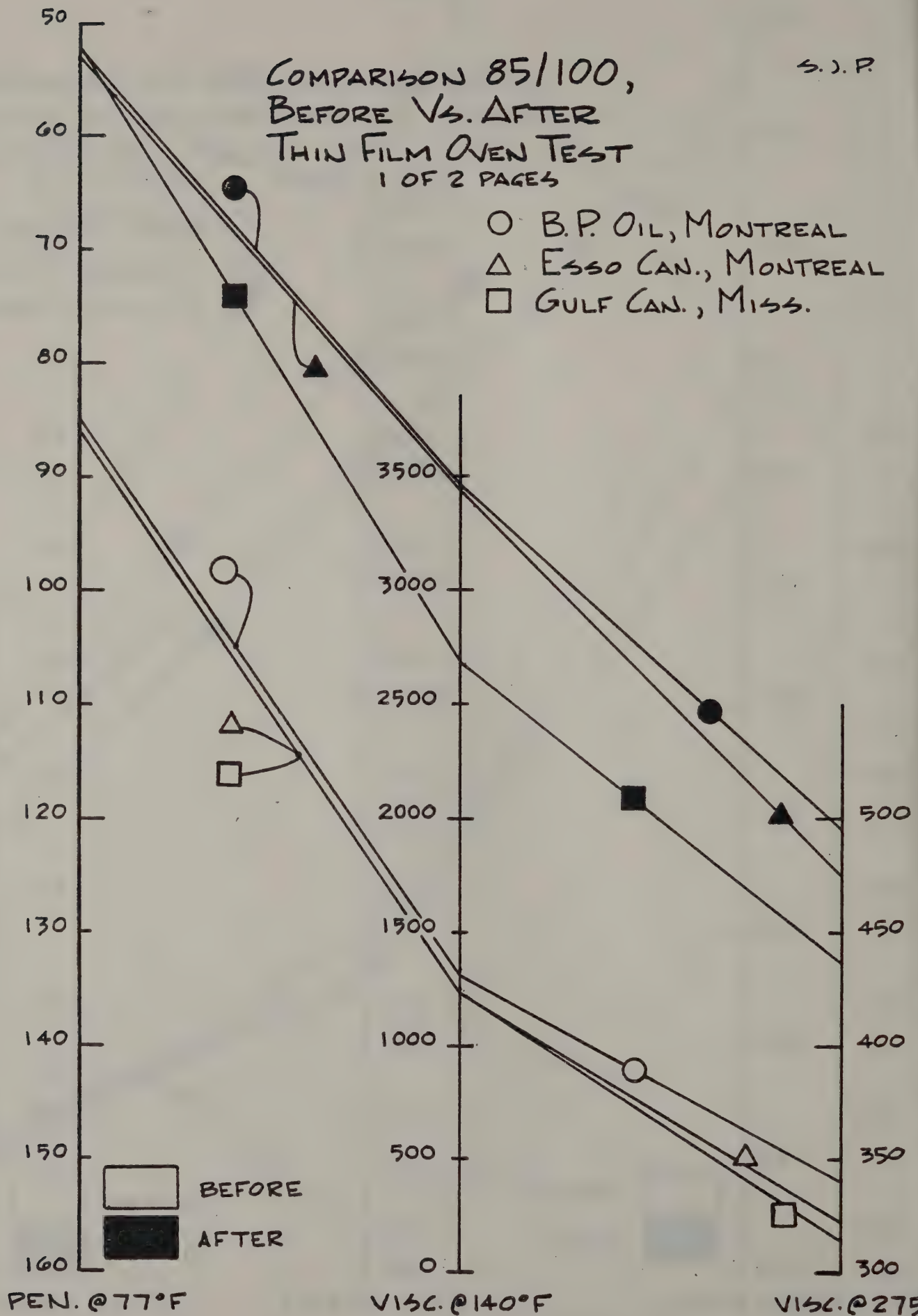


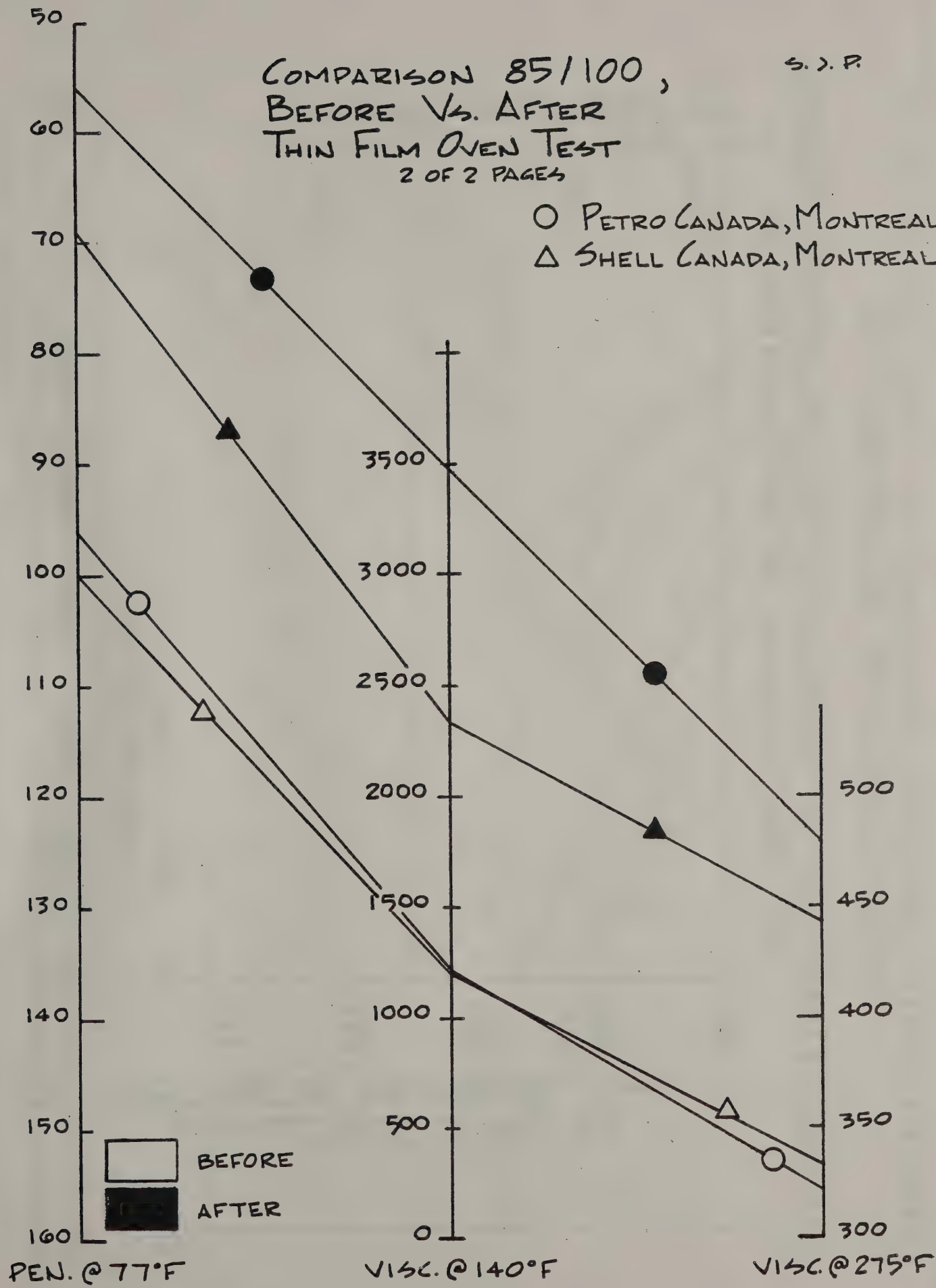
COMPARISON AC-15,
BEFORE VS. AFTER
THIN FILM OVEN TEST
2 OF 2 PAGES
S. J. P.
○ ASHLAND, TONAWANDA
△ UNITED REF., WARREN
40
50
60
70
80
90
100
110
120
130
140
150
3500
3000
2500
2000
1500
1000
500
550
500
450
400
350
BEFORE
AFTER
PEN. @ 77°F
VISC. @ 140°F
VISC. @ 275°F


COMPARISON AC-20, BEFORE VS. AFTER THIN FILM OVEN TEST
○ MARATHON, TONAWANDA
△ PARCO, ATHENS
□ WEST BANK, KEARNY
S.J.P.
1 OF 3 PAGES
BEFORE
AFTER
PEN. @ 77°F
VISC. @ 140°F
VISC. @ 275°F
40
50
60
70
80
90
100
110
120
130
140
150
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
700
650
600
550
500
450
400
350

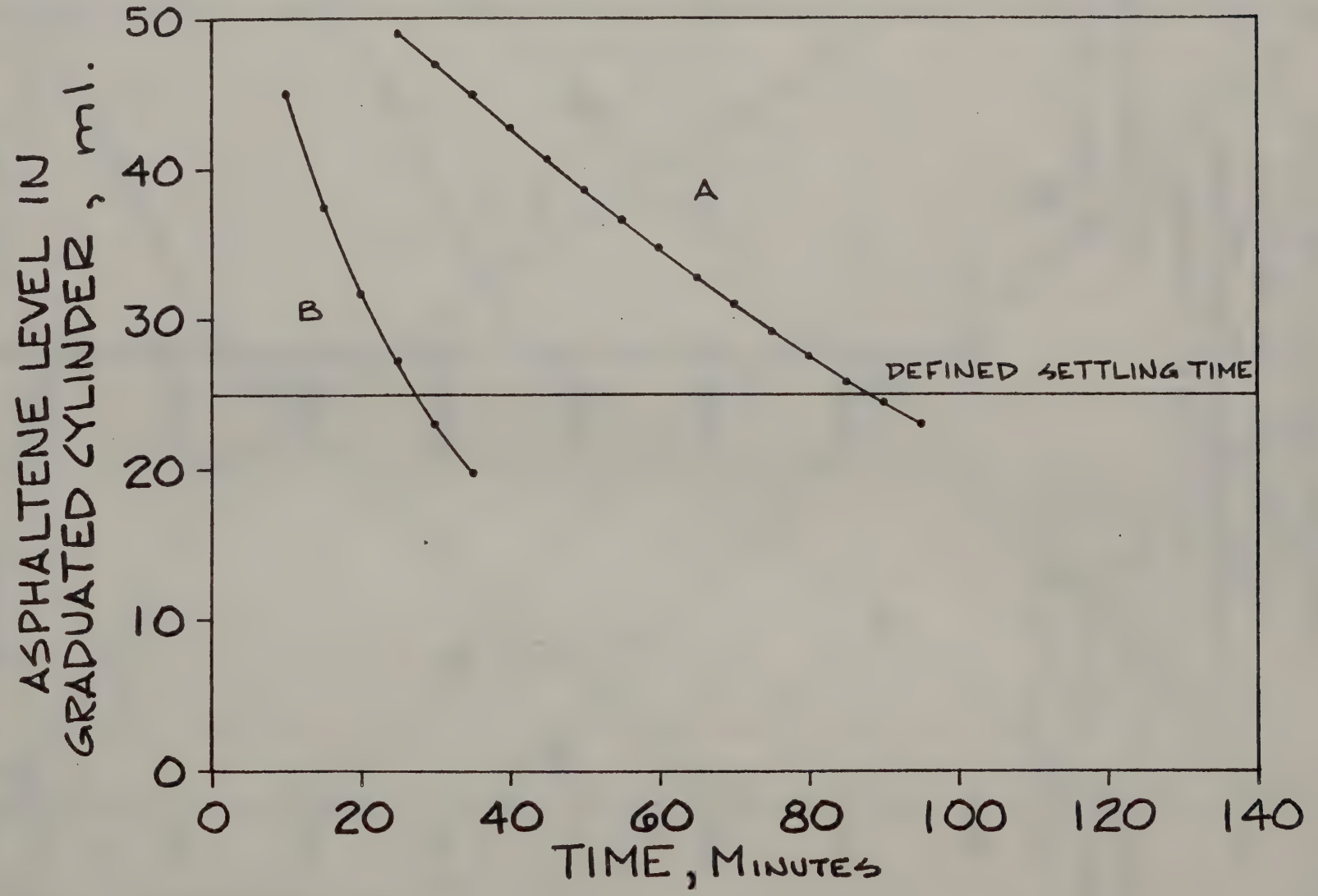

COMPARISON AC-20,
BEFORE VS. AFTER
THIN FILM OVEN TEST
2 OF 3 PAGES
○ CIBRO, ALBANY
S. J. P.
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
40
50
60
70
80
90
100
900
850
800
750
700
650
600
550
500
VISC. @ 140°F
VISC. @ 275°
BEFORE
AFTER
PEN. @ 77°F


COMPARISON AC-20,
BEFORE VS. AFTER
THIN FILM OVEN TEST
3 OF 3 PAGES
S.J.P.
ARCO, PHILADELPHIA
CHEVRON, P. AMBOY
EXXON, LINDEN
BEFORE
AFTER
40
50
60
70
80
90
100
110
120
130
140
150
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
600
550
500
450
400
350
PEN. @77°F
VISC. @140°F
VISC @ 275°F


COMPARISON 85/100,
BEFORE VS. AFTER
THIN FILM OVEN TEST
1 OF 2 PAGES
S.J.P.
B.P. OIL, MONTREAL
ESSO CAN., MONTREAL
GULF CAN., MISS.
BEFORE
AFTER
50
60
70
80
90
100
110
120
130
140
150
160
3500
3000
2500
2000
1500
1000
500
0
500
450
400
350
300
PEN. @77°F
VISC. @140°F
VISC. @275°F


COMPARISON 85/100,
BEFORE VS. AFTER
THIN FILM OVEN TEST
2 OF 2 PAGES
S. J. P.
○ PETRO CANADA, MONTREAL
△ SHELL CANADA, MONTREAL
50
60
70
80
90
100
110
120
130
140
150
160
PEN. @ 77°F
3500
3000
2500
2000
1500
1000
500
0
VISC. @ 140°F
500
450
400
350
300
VISC. @ 275°F
BEFORE
AFTER

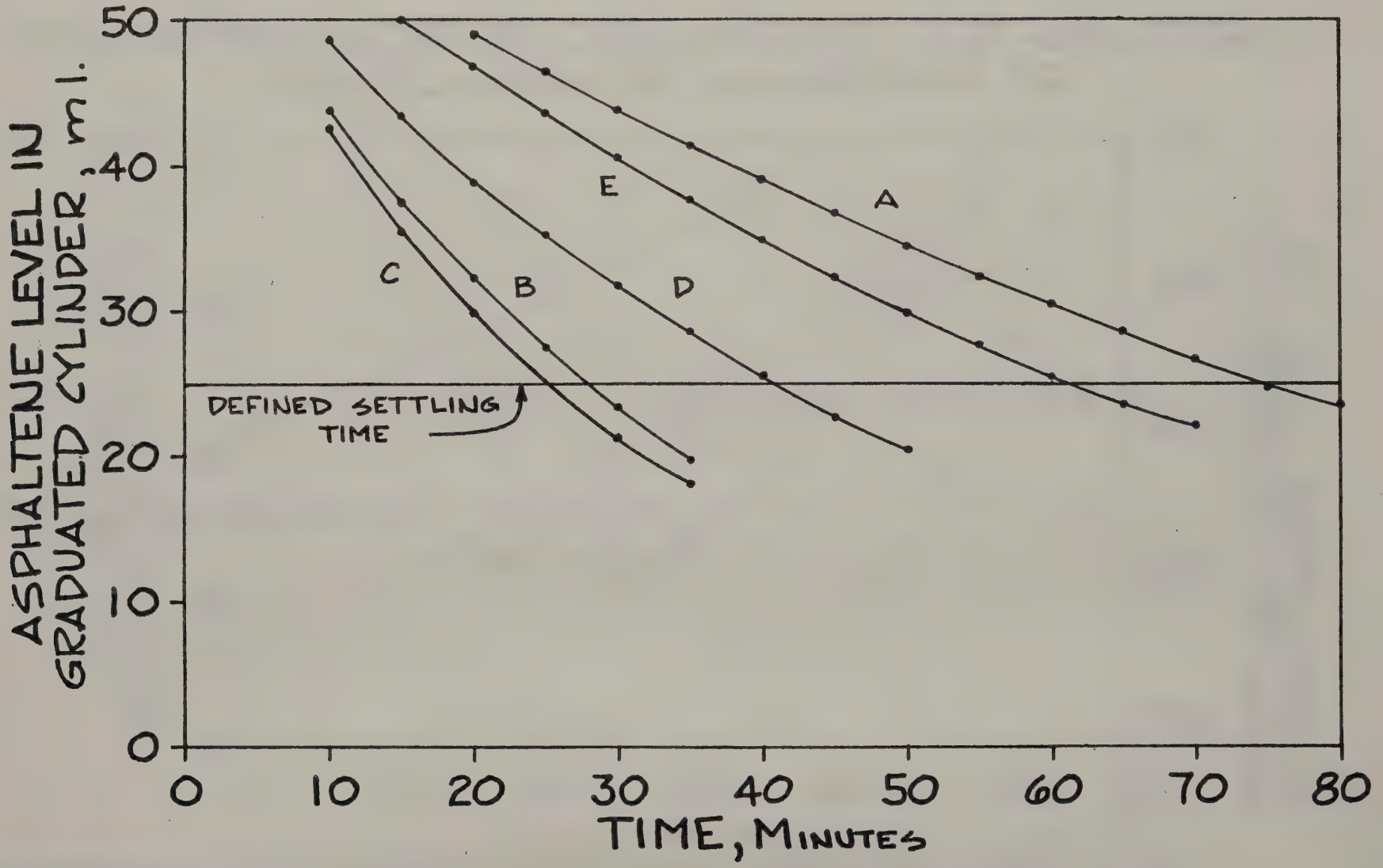
A SETTLING TEST TO EVALUATE THE RELATIVE DEGREE OF DISPERSION OF ASPHALTENES



A = AC-5, ASHLAND, TONAWANDA

B = AC-5, B.P. OIL, OAKVILLE

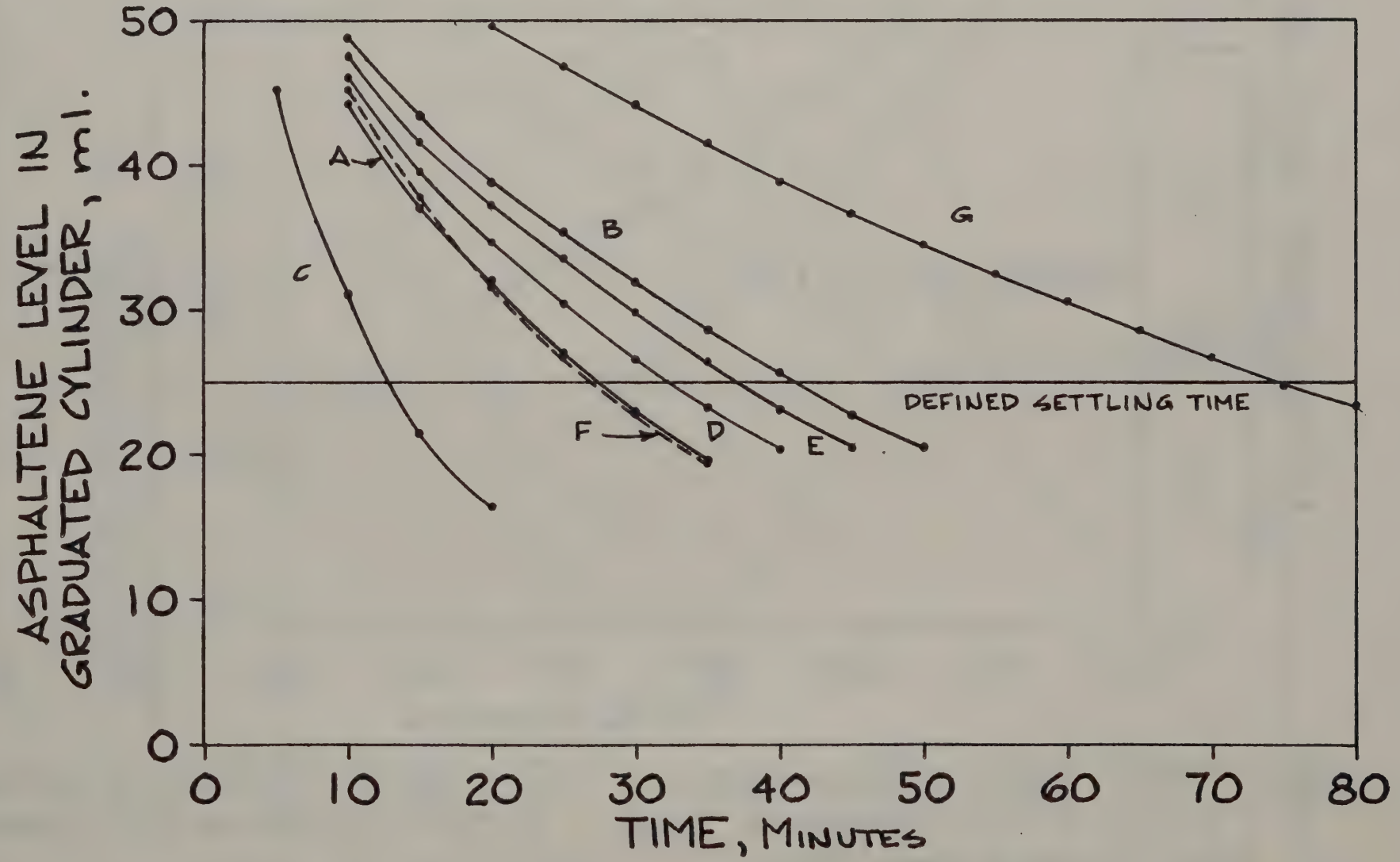
A SETTLING TEST TO EVALUATE THE RELATIVE DEGREE OF DISPERSION OF ASPHALTENES



A = AC-15, ASHLAND, TONAWANDA
B = AC-15, B.P. OIL, OAKVILLE
C = AC-15, GULF CAN., MISS.
D = AC-15, MARATHON, TONAWANDA
E = AC-15, UNITED REF., WARREN

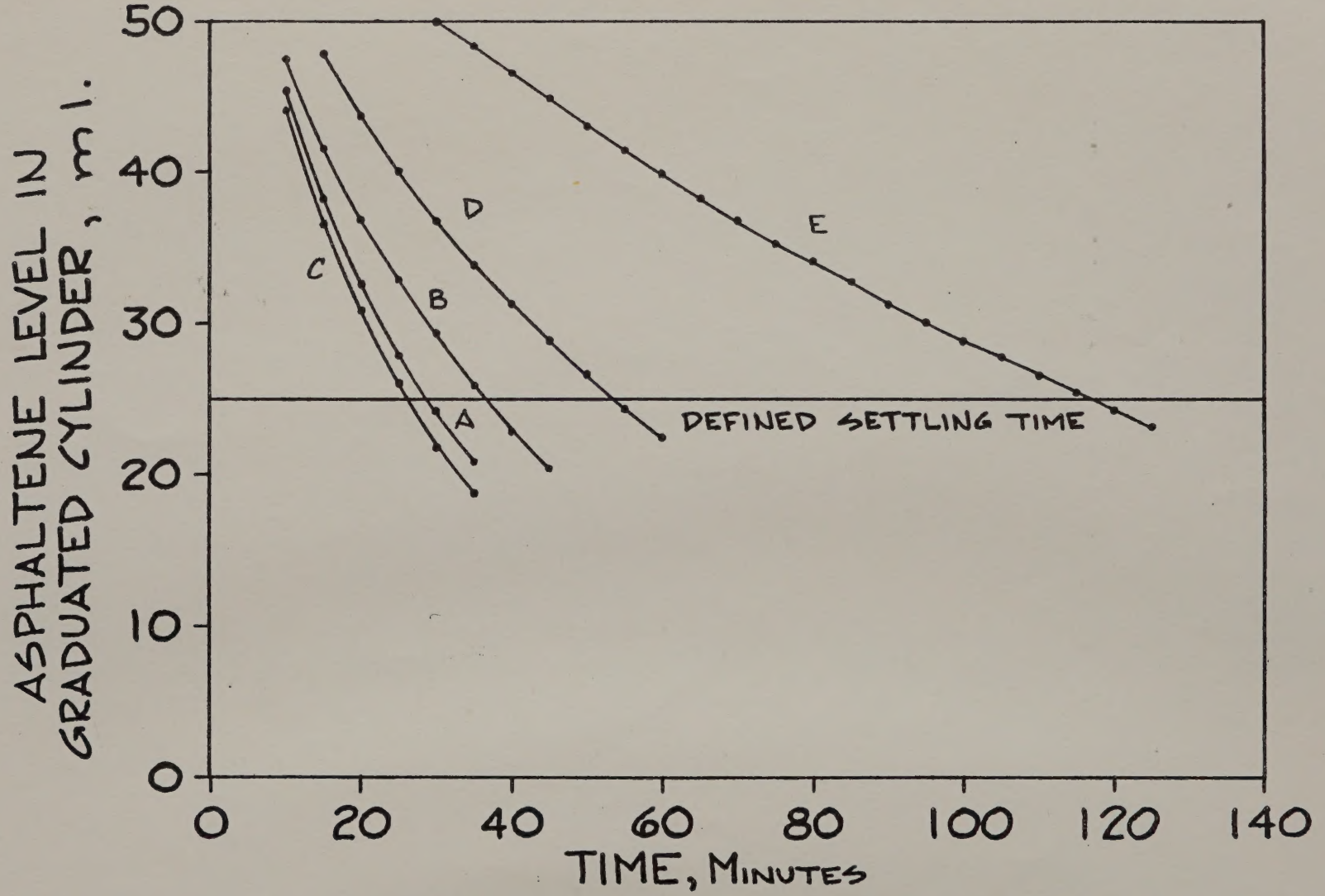
S.J.P.

A SETTLING TEST TO EVALUATE THE RELATIVE DEGREE OF DISPERSION OF ASPHALTENES



A = AC-20, ARCO, PHILADELPHIA
B = AC-20, CHEVRON, P. AMBOY
C = AC-20, CIBRO, ALBANY
E = AC-20, MARATHON, TONAWANDA
F = AC-20, PARCO, ATHENS
G = AC-20, WEST BANK, KEARNY

A SETTLING TEST TO EVALUATE THE RELATIVE DEGREE OF DISPERSION OF ASPHALTENES



A = 85/100, B.P. OIL, MONTREAL
B = 85/100, ESSO CAN., MONTREAL
C = 85/100, GULF CAN., MISS.
D = 85/100, PETRO CAN., MONTREAL
E = 85/100, SHELL CAN., MONTREAL

S.J.P.

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